

## DATA SHEET

### MODULETEK: SFP-OC48-SR-x-D10

OC-48 SR/STM I-16 SFP (Small Form Pluggable) Transceiver with Digital Diagnostics

### Overview

ModuleTek's SFP-OC48-SR-x-D10 OC-48/STM I-16 SFP optical transceivers are designed to comply with SONET/SDH standards at OC-48 SR/STM I-16 (2.488Gb/s) data rate. The SFP-OC48-SR-x-D10 SFP optical transceivers with digital diagnostics monitoring functionality provide a quick and reliable interface for OC-48/STM I-16 single mode applications. The digital diagnostics functions are available via a 2-wire serial bus. In addition, they comply with the Small Form Pluggable Multi-Source Agreement (MSA).

### Product Features

- Up to 2.67 Gb/s data links
- Compliant with SONET and SDH for OC-48/STM I-16 (2.488Gb/s)
- Compliant with SFP MSA
- Built-in digital diagnostics functions
- Hot-pluggable SFP footprint
- 1310nm FP laser transmitter
- Duplex LC connector
- Up to 2km on SMF
- Single power supply 3.3V
- RoHS Compliance
- Class 1 laser product complies with EN 60825-1
- Operating temperature range(Case Temperature):  
Commercial Level : 0°C to 70°C  
Industrial Level : -40°C to 85°C



### Applications

- SONET OC-48 SR/SDH STM I-16

## Ordering Information

| Part Number   | Product ID | Description  | Color on Clasp |
|---|------------|--|----------------|
| SFP-OC48-SR-C-D10   | M331801    | SONET OC48 SR/SDH STM I-16 SFP LC Connectors 1310nm SingleMode 2km,commercial temperature. | gray           |
| SFP-OC48-SR-I-D10   | M331802    | SONET OC48 SR/SDH STM I-16 SFP LC Connectors 1310nm SingleMode 2km,industrial temperature. | gray           |
| <b>For More Information:</b><br>ModuleTek Limited<br>Web: <a href="http://www.moduletek.com">www.moduletek.com</a><br>Email: <a href="mailto:sales@moduletek.com">sales@moduletek.com</a> |            |  |                |

## General Specifications

| Parameter             | Symbol    | Min  | Typ   | Max        | Unit | Remarks |
|-----------------------|-----------|------|-------|------------|------|---------|
| Data Rate             | DR        |      | 2.488 | 2.67       | Gb/s |         |
| Bit Error Rate        | BER       |      |       | $10^{-12}$ |      |         |
| Operating Temperature | $T_C$     | 0    |       | 70         | °C   | 1       |
|                       |           | -40  |       | 85         | °C   | 1       |
| Storage Temperature   | $T_{STO}$ | -40  |       | 85         | °C   | 2       |
| Supply Current        | $I_{CC}$  |      | 200   | 300        | mA   | 3       |
| Input Voltage         | $V_{CC}$  | 3.14 | 3.3   | 3.46       | V    |         |
| Maximum Voltage       | $V_{MAX}$ | -0.5 |       | 4.5        | V    | 3       |

### Notes:

1. Case temperature
2. Ambient temperature
3. For electrical power interface

## Transmission distance

| Data Rate | Optical Fiber type        | Distance range (km) | Remark |
|-----------|---------------------------|---------------------|--------|
| 2.488Gb/s | 9/125um Singel mode fiber | 2                   |        |

## Optical – Characteristics – Transmitter

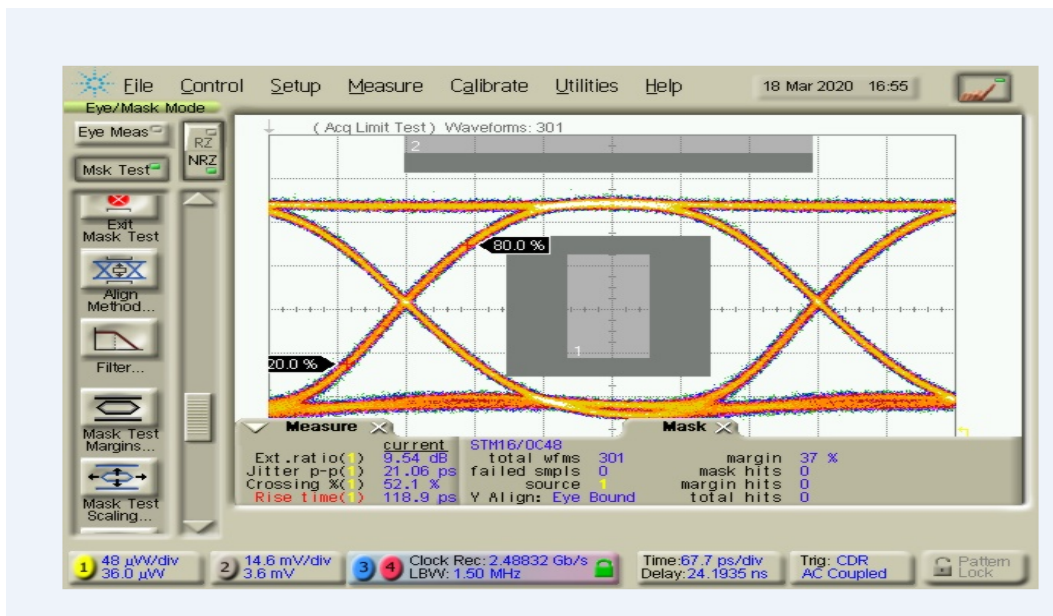
$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

| Parameter                        | Symbol          | Min  | Typ | Max  | Unit | Remarks |
|----------------------------------|-----------------|------|-----|------|------|---------|
| Output Optical Power             | $P_{TX}$        | -9.5 |     | -3   | dBm  | 1       |
| Optical Center Wavelength        | $\lambda_c$     | 1260 |     | 1360 | nm   |         |
| Extinction Ratio                 | ER              | 9    | 11  |      | dB   |         |
| Spectral Width (RMS)             | $\Delta\lambda$ |      |     | 5    | nm   |         |
| Optical Rise/Fall Time (20%-80%) | $t_r / t_f$     |      | 250 | 300  | ps   |         |

### Notes:

1. Class 1 Product

## Typical Eye Diagram



Data pattern: 2.488Gb/s, PRBS 2<sup>23</sup>-1

## Optical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

| Parameter                 | Symbol       | Min  | Typ | Max  | Unit | Remarks |
|---------------------------|--------------|------|-----|------|------|---------|
| Receiver Overload         | $P_{OL}$     | 0    |     |      | dBm  |         |
| Optical Center Wavelength | $\lambda_C$  | 1270 |     | 1600 | nm   |         |
| Receiver Sensitivity      | $R_{X\_SEN}$ |      |     | -18  | dBm  |         |
| LOS Assert                | $LOS_A$      | -30  |     |      | dBm  |         |
| LOS De-Assert             | $LOS_D$      |      |     | -20  | dBm  |         |
| LOS Hysteresis            | $LOS_H$      | 0.5  |     |      | dB   |         |

## Electrical – Characteristics – Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

| Parameter                     | Symbol       | Min          | Typ | Max          | Unit     | Remarks |
|-------------------------------|--------------|--------------|-----|--------------|----------|---------|
| Input differential impedance  | $R_{IN}$     |              | 100 |              | $\Omega$ |         |
| Single ended data input swing | $V_{IN\_PP}$ | 250          |     | 1200         | mV       |         |
| Transmit disable voltage      | $V_D$        | $V_{CC}-1.3$ |     | $V_{CC}$     | V        |         |
| Transmit enable voltage       | $V_{EN}$     | $V_{EE}$     |     | $V_{EE}+0.8$ | V        |         |
| Transmit disable assert time  |              |              |     | 10           | $\mu s$  |         |

## Electrical – Characteristics – Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C$

| Parameter                            | Symbol                                  | Min          | Typ | Max            | Unit           | Remarks |
|--------------------------------------|---|--------------|-----|----------------|----------------|---------|
| Single ended data output swing       | $V_{OUT\_PP}$                           | 300          | 400 | 800            | mV             |         |
| Data output rise/fall time (20%-80%) | $t_r/t_f$                               |              | 100 | 175            | ps             |         |
| LOS Fault                            | $V_{LOS\_A}$                            | $V_{CC}-0.5$ |     | $V_{CC\_HOST}$ | V              |         |
| LOS Normal                           | $V_{LOS\_D}$                            | $V_{EE}$     |     | $V_{EE}+0.5$   | V              |         |
| <b>RX Squelch</b>                    | <b>Method of RX squelch implemented</b> |              |     |                | <b>Remarks</b> |         |
| Not implemented                      | N.A                                     |              |     |                |                |         |

## A0H Device register description

| IIC Site | Byte size | Register name          | Register description   | Value(HEX)                 |
|----------|-----------|------------------------|--|----------------------------|
| 0        | 1         | Identifier             | SFP  | 03                         |
| 1        | 1         | Extended Identifier    | Use the IIC interface  | 04                         |
| 2        | 1         | Connector              | Use the LC connector   | 07                         |
| 3-10     | 8         | Transceiver            | Transmitter Code   | 00 11 00 00<br>42 00 01 04 |
| 11       | 1         | Encoding               | NRZ  | 03                         |
| 12       | 1         | BR, Nominal            | 2.67Gb/s nominal rate  | 1B                         |
| 13       | 1         | Rate Identifier        | No rate selection  | 00                         |
| 14       | 1         | Length(9μm)-km         | In single-mode fiber transmission 2km  | 02                         |
| 15       | 1         | Length (9μm)-100m      | In single-mode fiber transmission 2km  | 14                         |
| 16       | 1         | Length (50μm)-10m      | The transmission distance in the multimode fiber   | 00                         |
| 17       | 1         | Length (62.5μm)-10m    | The transmission distance in the multimode fiber   | 00                         |
| 18       | 1         | Length (Copper)        | The transmission distance over the copper cable  | 00                         |
| 19       | 1         | Reserved               | Undefined  | 00                         |
| 20-35    | 16        | Trade name             | MODULETEK  | ASCII Format               |
| 36       | 1         | Transceiver            | Undefined  | 00                         |
| 37-39    | 3         | Vendor OUI             | Vendor IEEE company ID   | 00 00 00                   |
| 40-55    | 16        | Vendor PN              | Vendor's product model   | Vendor defined             |
| 56-59    | 4         | Vendor Revision Number | Vendor's product version number  | Vendor defined             |
| 60-61    | 2         | Wavelength             | The laser has a wavelength of 1310 nanometers  | 05 1E                      |
| 62       | 1         | Reserved               | Undefined  | 00                         |
| 63       | 1         | CC_BASE                | 0-62 Check and of bytes  | Vendor defined             |
| 64-65    | 2         | Transceiver Options    | 1.Rx_LOS Sigal monitoring<br>2.Tx_FAULT Sigal monitoring<br>3.Tx_DIS Sigal monitoring                      | 00 1A                      |
| 66       | 1         | BR, max                | High bit rate margin   | 00                         |
| 67       | 1         | BR, min                | Low bit rate margin  | 00                         |
| 68-83    | 16        | Vendor SN              | Vendor serial number   | Vendor defined             |
| 84-91    | 8         | Date code              | The date code  | Vendor defined             |
| 92       | 1         | Monitoring Type        | DOM Information internal calibration<br>The received light power is measured using the average light power | 68                         |

|         |     |                  |   |                |
|---------|-----|------------------|---|----------------|
| 93      | 1   | Enhanced Options | 1. Emitting light and receiving light alarm and warning monitoring<br>2. Tx_DIS Signal monitoring and control<br>3. Rx_LOS Signal monitoring<br>4. Tx_FAULT Signal monitoring | F0             |
| 94      | 1   | Compliance       | As defined in SFF-8472 in version 12.0  | 08             |
| 95      | 1   | CC_EXT           | 64-94 Check and bytes   | Vendor defined |
| 96-127  | 32  | Vendor Specific  | Vendor custom areas   | Vendor defined |
| 128-255 | 128 | Vendor Specific  | Vendor custom areas   | Vendor defined |

## Digital Diagnostic Functions

SFP-OC48-SR-x-D10 supports the 2-wire serial communication protocol as defined in SFP MSA . Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-OC48-SR-x-D10 are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFP MSA , alerts the user when a particular operating parameter exceeds the factory-set normal range.

## DDM Threshold Information

| Parameter         |   | Alarm Threshold |                | Warning Threshold |                |
|-------------------|---|-----------------|----------------|-------------------|----------------|
|                   |   | High Value      | Low Value      | High Value        | Low Value      |
| Temp (°C)         | C | 75 (4B 00)      | -5 (FB 00)     | 70 (46 00)        | 0(00 00)       |
|                   | I | 90 (5A 00)      | -45 (D3 00)    | 85 (55 00)        | -40 (D8 00)    |
| Voltage (V)       |   | 3.63(8D CC)     | 2.97 (74 04)   | 3.46 (87 28)      | 3.13 (7A 44)   |
| Bias Current (mA) |   | 100 (C3 50)     | 2 (03 E8)      | 80 (9C 40)        | 4 (07 D0)      |
| Tx Power (dBm)    |   | -2.21 (17 7E )  | -10.47 (03 81) | -3 (13 93)        | -9.5 (04 62)   |
| Rx Power (dBm)    |   | 3.01 (4E 20)    | -30.46 (00 09) | 0 (27 10)         | -27.21 (00 13) |



ROSA (light-receiving component), the ROSA includes a PIN photodetector and a transimpedance amplifier chip. When the ROSA detects the incident light signal, it will be converted into a photo-generated current by the PIN photodetector. The photo-generated current is converted into an electrical signal after passing through the transimpedance amplifier. The electrical signal is further amplified by the limiting amplifier of the intelligent transceiver chip, then outputs a fixed-amplitude electrical signal to the host.

When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX\_LOS pin is high (logic "1"), which can be used to diagnose whether the physical signal is normal. The signal is operated in TTL level. The implementation method of RX\_LOS is OMA (optical modulation amplitude).

The microprocessor inside the module monitors the module's operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

## A0h/A2h Write Protection

Security Level 1 Password:

| Password Entry ADDR | Size | Vaules(hex) | Remark |
|---------------------|------|-------------|--------|
| Page A2h, 7Bh-7Eh   | 4    | 12 34 56 78 |        |

After the module is powered on, the read value of the security level access registers 7Bh to 7Eh of A2h is replaced with 0xFFh.

After entering the security level 1 working state, the user can directly write to the contents of the A0h device address and Table 00h and Table 01h of A2h device address.

And this version of the module does not support users to modify the security level 1 password.

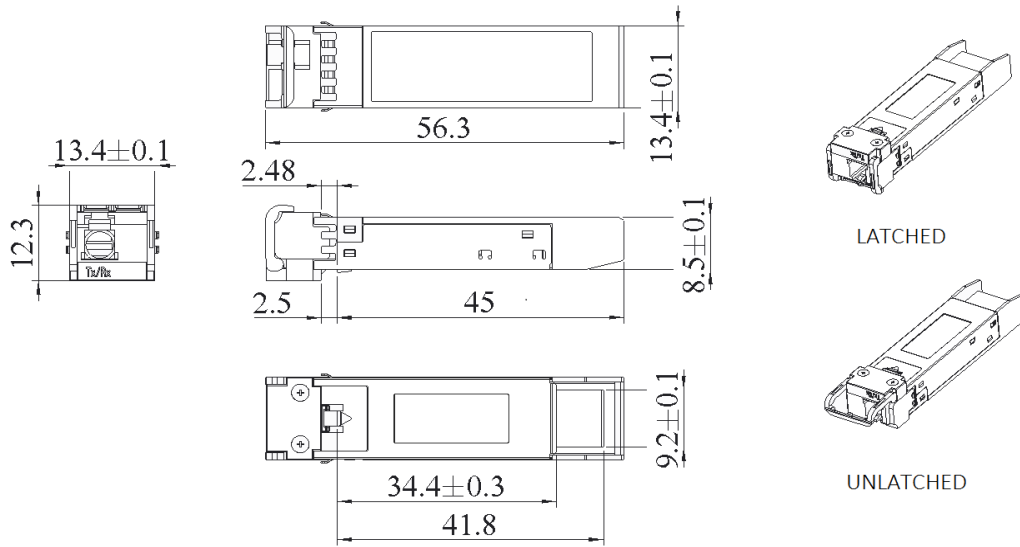
## Product weight

Net weight of module: 18.5g/pcs

Net weight of dust cap: 0.65g/pcs

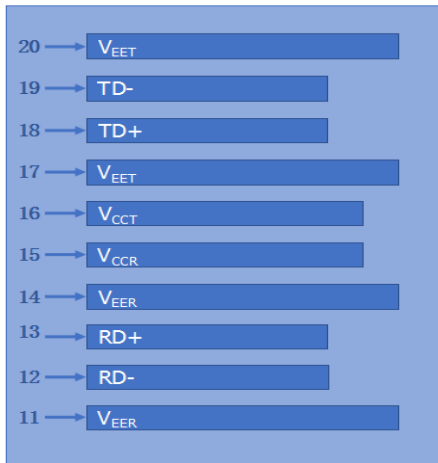


## Dimensions

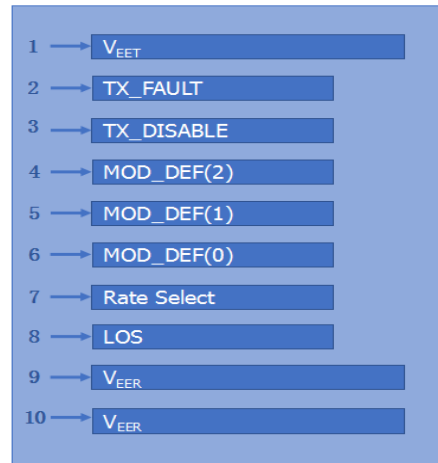


ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

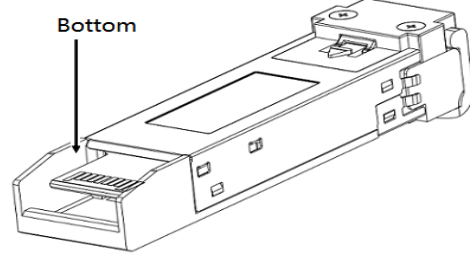
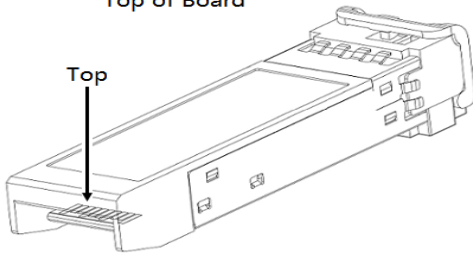
## Electrical Pad Layout



Top of Board



Bottom of Board



## Pin Assignment

| PIN # | Symbol           | Description   | Remarks |
|-------|------------------|---|---------|
| 1     | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |
| 2     | TX_FAULT         | Transmitter Fault. Not supported                              |         |
| 3     | TX_DISABLE       | Transmitter Disable. Laser output disabled on high or open    | 2       |
| 4     | MOD_DEF(2)       | Module Definition 2. Data line for serial ID                  | 3       |
| 5     | MOD_DEF(1)       | Module Definition 1. Clock line for serial ID                 | 3       |
| 6     | MOD_DEF(0)       | Module Definition 0. Grounded within the module               | 3       |
| 7     | Rate Select      | No connection required  |         |
| 8     | LOS              | Loss of Signal indication. Logic 0 indicates normal operation | 4       |
| 9     | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 10    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 11    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 12    | RD-              | Receiver Inverted DATA out. AC coupled                        |         |
| 13    | RD+              | Receiver Non-inverted DATA out. AC coupled                    |         |
| 14    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 15    | V <sub>CCR</sub> | Receiver power supply   |         |
| 16    | V <sub>CCT</sub> | Transmitter power supply                                      |         |
| 17    | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |
| 18    | TD+              | Transmitter Non-Inverted DATA in. AC coupled                  |         |
| 19    | TD-              | Transmitter Inverted DATA in. AC coupled                      |         |
| 20    | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T<sub>DIS</sub> > 2V or open, Enabled: T<sub>DIS</sub> < 0.8V
3. Should Be pulled up with 4.7k – 10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

## References

1. IEEE standard 802.3. IEEE Standard Department, 2005.
2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
3. Bellcore GR-253 and ITU-T G.957 Specifications.